APPLICATION NO. 09/826,117

TITLE OF INVENTION: Hybrid Walsh Codes for CDMA

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CLAIMS

WHAT IS CLAIMED IS:

Claim 1. (cancelled)

Claim 2. (cancelled)

Claim 3. (cancelled)

Claim 4. (cancelled)

Claim 5. (cancelled)

Claim 6. (cancelled)

Claim 7. (currently amended) A ~~means~~ method for ~~the design and implementation of encoders and decoders for~~ generation of ~~Hybrid~~ hybrid Walsh complex orthogonal codes for CDMA, said method comprising the steps:

classify the N=2^M N-chip Walsh codes into even codes and odd codes according to their even and odd properties about their code centers for integer M,

said Walsh codes by definition are the {+1,-1} valued N orthogonal Hadamard codes re-ordered according to their sequency values where sequency is the average rate of phase changes over each N chip code length,

classify the N N-sample discrete real Fourier transform codes into even codes and odd codes and re-order said codes according to increasing frequency,

construct a one-to-one correspondence of said N real Walsh codes

with said N real Fourier transform codes such that sequency corresponds to frequency, even codes correspond to even codes, and odd codes correspond to odd codes,

construct a mapping which uses said N real Fourier codes for the real and imaginary axis codes of the N N-sample discrete complex Fourier transform (DFT) codes and,

use said mapping combined with said correspondence to generate the real and imaginary axis component codes of said hybrid Walsh codes $\tilde{W}(u)$ for code index u=0,1,2,. . .,N-1 as re-orderings of said real Walsh codes W(u) for u=1,2,. . .,N-1 defined by the equations

for u = 0, $\tilde{W}(u) = W(0) + jW(0)$,

for u = 1,2,…,N/2-1, $\tilde{W}(u) = W(2u) + jW(2u-1)$,

for u = N/2, $\tilde{W}(u) = W(N-1) + jW(N-1))$, and

for u = N/2+1,…,N-1, $\tilde{W}(u) = W(2N-2u-1) + jW(2N-2u)$.

~~CDMA channelization codes over a frequency band with properties~~

~~inphase (real) codes are equal to a lexicographic reordering permutation of the Walsh code~~

~~quadrature (imaginary) codes are equal to a lexicographic reordering permutation of the Walsh code~~

~~codes have a 1-to-1 sequency-frequency correspondence with the DFT codes~~

~~codes have 1-to-1 even-cosine and odd-sine correspondences with the DFT codes~~

~~codes take values {1+j, -1+j, -1-j, 1-j}~~

~~codes take values {1, j, -1, -j} with a (-45) rotation of axes and a renormalization~~

~~codes have fast encoding and fast decoding algorithms~~

~~encoders are implemented in CDMA transmitters for representative embodiments as complex multiply channelization encoding of the inphase and quadrature data replacing the Walsh real multiply channelization encoding of the inphase and quadrature data, prior to covering by long and short complex PN codes~~

~~decoders are implemented in CDMA receivers for representative embodiments as complex conjugate transpose multiply decoding of the inphase and quadrature encoded data replacing the Walsh real multiply decoding of the inphase and quadrature encoded data, after decovering by short and long complex PN codes~~

Claim 8. (currently amended) The method of claim **7** wherein said codes have properties:

code chips take values {1+j, -1+j, -1-j, 1-j} in the complex plane,

code chips with a renormalization and rotation of the code matrix take values {1, j, -1, -j} in said complex plane,

inphase axis codes of said codes are re-ordered Walsh or Hadamard codes and,

quadrature axis codes of said codes are re-ordered Walsh or Hadamard codes.

~~A means for the design and implementation of encoders and decoders for generalized Hybrid Walsh complex orthogonal CDMA channelization codes over a frequency band with properties~~

~~codes can be constructed for a wide range of code lengths by combining with DFT and quasi-orthogonal PN codes using tensor product, direct product, and functional combining~~

~~codes can be constructed as tensor products with DFT codes and quasi-orthogonal PN codes and other codes~~

~~codes can be constructed as direct products with DFT codes and quasi-orthogonal PN codes and other codes and with functional combining~~

~~codes are complex valued~~

~~codes have fast encoding and fast decoding algorithms.~~

~~encoders are implemented in CDMA transmitters for representative embodiments as complex multiply channelization encoding of the inphase and quadrature data replacing the Walsh real multiply channelization encoding of the inphase and quadrature data, prior to covering by long and short complex PN codes~~

~~decoders are implemented in CDMA receivers for representative embodiments as complex conjugate transpose multiply decoding of the inphase and quadrature encoded data replacing the Walsh real multiply decoding of the inphase and quadrature encoded data, after decovering by short and long complex PN codes~~

Claim 9. (currently amended) A ~~means~~ method for generation of gemeralized hybrid Walsh orthogonal codes for CDMA from code sets which include said hybrid Walsh, said Hadamard, said Walsh, said DFT, and pseudo-noise PN, said method comprising:

tensor product also called Kronecker product is used to construct said codes,
direct product is used to construct said codes,
functional combining is to construct said codes and,
combinations of tensor products, direct products, and functional combining are used to construct said codes.

Claim **10**. (cancelled) ~~A means for the design and implementation of encoders and decoders for complex orthogonal CDMA channelization codes over a frequency band with properties~~

~~codes can be constructed for a wide range of code lengths by combining with DFT and quasi-orthogonal PN codes using tensor product, direct product, and functional combining~~

~~codes can be constructed as tensor products with DFT codes and quasi-orthogonal PN codes and other codes~~

~~codes can be constructed as direct products with DFT codes and quasi-orthogonal PN codes and other codes and with functional combining~~

~~codes are complex valued~~

~~codes have fast encoding and fast decoding algorithms~~

~~encoders are implemented in CDMA transmitters for representative embodiments as complex multiply channelization encoding of the inphase and quadrature data replacing the Walsh real multiply channelization encoding of the inphase and~~

~~quadrature data, prior to covering by long and short complex PN codes~~

~~decoders are implemented in CDMA receivers for representative embodiments as complex conjugate tanspose multiply decoding of the inphase and quadrature encoded data replacing the Walsh real multiply decoding of the inphase and quadrature encoded data, after decovering by short and long complex PN codes~~

~~means design and implementation of encoders and decoders for generalized CDMA channelization codes over a frequency band with propertiescodes can be constructed for a wide range of code lengths by combining with DFT and quasi-orthogonal PN codes using tensor product, direct product, and functional combining codes can be constructed as tensor products with DFT codes and quasi-orthogonal PN codes and other codes~~

~~codes can be constructed as direct products with DFT codes and quasi-orthogonal PN codes and other codes and with functional combiningcodes are complex valuedcodes have fast encoding and fast decoding algorithms~~

~~encoders are implemented in CDMA transmitters for representative embodiments as complex multiply channelization encoding of the inphase and quadrature data replacing the Walsh real multiply channelization encoding of the inphase and quadrature data, prior to covering by long and short complex PN codes~~

~~decoders are implemented in CDMA receivers for representative embodiments as complex conjugate transpose multiply decoding of the inphase and quadrature encoded data replacing the Walsh real multiply decoding of the inphase and~~

~~quadrature encoded data, after decovering by short and long complex PN codes~~